

What drives Green Technical Vocational Education and Training in Ghana's Solar Sector?

Norbert Edomah

School of Science and Technology, Pan-Atlantic University, Lagos Nigeria
Email: nedomah@pau.edu.ng

1. Introduction

Ghana, a country in West Africa with a population of approximately 33 million people, has a very vibrant and dynamic energy sector. With an energy access rate of approximately 89%, Ghana has one of Africa's best energy security scenarios. With an installed electricity generation capacity is 4,500MW consisting of Hydro 29%, Thermal 68% and Solar approximately 3% [1,2], Ghana has continued to pursue and enhance its renewable energy potential driven primarily by the 2030 target of having 10% of the energy mix from renewable energy sources, particularly solar energy [3].

Ghana has also made giant strides in Technical Vocational Education and Training (TVET) to support the energy and industrial sectors through some TVET delivery reforms. However, how does the current TVET regulatory and governance landscape in Ghana impact on the provision of skilled manpower in the Ghanaian solar sector? What are the current barriers and drivers to solar systems adoption and use in Ghana? This factsheet aims to provide answers to these questions and other valuable insights on the greening of the solar sector in Ghana.

2. TVET in the Ghanaian educational system

Similar to other African country contexts, Ghana's educational sector has the traditional progressive general education system and the TVET system as shown in figure 1. There are three main forms of TVET systems in Ghana. These are:

- a. The **formal TVET system**, which are institutionalized, intentional and planned programmes offered in public or private recognized educational establishments. They are aimed at providing access to structured lifelong learning resources and these trainings (and the institutions offering the trainings) are often regulated by a constituted government authority. Most solar trainings in Ghana offered in universities, research institutes and energy centres (such as the Research Centre for Energy and Environmental Studies at the University of Energy and Natural Resources, Sunyani, and the Brew Hammond Energy Centre at the Kwame Nkrumah University of Science and Technology) and TVET institutions (such as Don Bosco Vocational Institute Sunyani and the Suame Technical Institute Kumasi) follow the formal system.
- b. The **non-formal TVET systems**, which occur outside the formal school system, are those training arrangements that have some sort of structure, no structured curriculum, but are more flexible. They often take place in workplaces and community-based settings through activities of trade associations, non-governmental and civil society organizations. Green Solar Academy is an example of a non-formal TVET system offering solar training in Ghana.

- c. The **informal TVET systems**, which are largely unstructured trainings, offer no structured or systematic approach to skills development. However, many informal sector provided trainings are driven not necessarily by the broader market assessments and needs, but on the ability of the people to solve some proximate short-term problems, Informal training in the solar sector in Ghana happens mostly among solar systems designers and installers where they provide specific trainings to their trainees in an aspect that helps them fulfil their job functions.

Within the Ghanaian context, there has been an intentional move to formalize the skills gained through the informal and non-formal system using the Competency Based Training (CBT) and assessment system. This has proven to be very effective in certifying the skills gained while also helping people to know where they are deficient and need further trainings. The CBT system was formally incorporated into the TVET system and is clearly reflected within the educational cycles of the Ghanaian educational system. Solar training is now being incorporated into existing curriculum of the electrical installation courses at the TVET level. This is the clear case of the Don Bosco Vocational Institute in Sunyani and the Suame Technical Institute in Kumasi. A corresponding solar systems CBT assessment and certification scheme has also been developed and is being implemented.



Figure 1: Education pathway for general academic and TVET education in Ghana (Source: [4])

There are three educational cycles in Ghana: cycle 1 essentially deals with basic education which is compulsory for all Ghanaians; cycle 2 consist of secondary education with two pathways of either the conventional senior high school or the TVET education; and cycle 3 consisting of tertiary education as shown in table 1. The Ghanaian educational sector offers eleven years of compulsory education at nursery (2 years), primary (6 years) and junior secondary levels (3 years) all offered within the first cycle of basic education. However, there has been a growth in enrolment of students in secondary TVET education due to the recent introduction of the free education policy by the Ghanaian government at the secondary and tertiary levels. Most solar trainings in Ghana happen in cycles 2 and 3 mostly in TVET institutions and universities.

Table 1: Educational cycles and pathways in Ghana for TVET and conventional education (Adapted from [5])

Cycles	Levels	Age (guide) Years	Qualifications	
			Conventional academic	TVET
3rd cycle (Tertiary Education)	University Technical University Training Colleges Specialized institutes	18 and above	Doctorate Masters Post graduate diploma Bachelor's Diploma	Doctorate (DTech) Masters Bachelor of Technology (BTech) Higher National Diploma (HND) Full Technological Certificate (FTC) *Apprenticeships
Cycle 2 (Secondary education)	Post-secondary, Non-tertiary		Ordinary National Diploma (OND)	Technician Part 1 Certificate *Apprenticeships
	Senior high school	15 - 18	West Africa Senior School Certificate	National Certificates (I & II) Intermediate Crafts Technician grades *Apprenticeships
Cycle 1 (Basic education)	Junior secondary	12 - 15 (3 yrs)	Junior high school certificate	Junior high school certificate *Apprenticeship
	Primary	6- 12 (6 yrs)	No formal qualification	Proficiency II
	Nursery/Kindergarten	4 - 6 (2 yrs)	No formal qualification	Proficiency I

3. Governance frameworks driving TVET training in Ghana

The Ministry of Education primarily manages and governs the TVET system. Prior to the reorganization of the TVET system in Ghana, several ministries and agencies were involved in TVET programme development and delivery which resulted to an uncoordinated system that made it difficult for quality assurance management. Some of them include: the Ministry of Employment and Labour Relations; Ministry of Trade and Industry; Ministry of Health; Ministry of Local Government and Rural Development; Ministry of Gender, Children and Social Protection; Ministry of Food and Agriculture; Ministry of Youth and Sports; among others. Indeed, the Pre-Tertiary Education Act, 2020, established and empowered two institutions of government tasked with the responsibility of managing the TVET system in Ghana. These are:

- a. **The Commission for Technical and Vocational Education and Training (CTVET):** The CTVET has the primary responsibility for promoting, administering and regulating Technical Vocational Education and Training (TVET) in Ghana. The CTVET is responsible for the coordination and supervision of the TVET system with the mandate to plan, coordinate and support all aspects of TVET at the national level [6]. The Council is supported by five standing technical committees, namely:
 - i. The National TVET Qualifications Committee (NTVETQC) responsible for the pre-qualification and inclusion of new TVET programmes.
 - ii. The Sector Skills Committee comprising different skills sector boards representing different industrial and professional disciplines.
 - iii. The Quality Assurance Committee with primary responsibility for quality assurance in TVET.
 - iv. The Ghana Skills Development Fund Committee responsible for seeking innovative ways to fund TVET education and delivery.
 - v. The Enforcement Committee responsible for the enforcement of TVET regulations and policies.

- b. **The Technical and Vocational Education and Training Service (TVET Service),** responsible for overseeing, managing, and implementing approved national policies and programmes relating to pre-tertiary technical vocational education and training. This includes:
 - i. Construction, maintenance and equipping of TVET institutions
 - ii. Implementing curriculum for TVET programmes in collaboration with industry and regulatory bodies
 - iii. Updating the register of TVET institutions and trainers
 - iv. Providing recommendations for TVET policies and programmes

The CTVET have developed a curriculum for Solar systems installation and maintenance that is embedded within the electrical installations course at TVET level. There is also a stand-alone course on solar systems that follows the CBT assessment and certification models at levels 1 and 2. The TVET Service works closely with TVET schools and other relevant stakeholders (including the relevant skills sector boards) to ensure the effective implementation of the programme in approved TVET schools in Ghana.

4. Key drivers and barriers impacting solar systems adoption and use in Ghana

The key drivers impacting on the greater need solar systems training in Ghana are summarized in table 2.

Table 2: drivers and barriers impacting solar systems adoption and use in Ghana

s/n	Drivers/barriers	Description
1	Addressing the energy access challenge	<ul style="list-style-type: none"> • There is a high level of electricity access (89%) in Ghana. • Solar adoption and use is largely viewed as a way to reduce energy cost since grid electricity is very expensive. Hence, the need for more skilled manpower in solar systems installation and maintenance. • Government investment in solar minigrid has targeted isolated communities that grid electricity may take some time to reach. This further highlights the need for skilled solar technicians who can maintain the solar infrastructure in isolated communities.

2	Governance challenges	<ul style="list-style-type: none"> • There are good policies and targets favouring solar adoption. For example, the 2030 target that sets renewables as 10% of the total energy mix (mostly to be achieved with solar). There is also a net metering policy whose pilot implementation would begin in early 2025. • Stakeholders are very knowledgeable about what to do and they are taking the necessary action. • Government actions are viewed as slow with respect to implementation of some policies that favours solar adoption. For example, the delayed implementation of net metering policy. • TVET governance structure (comprising national, regional and local directors/heads) is viewed as effective in addressing emerging issues (particularly solar training) much faster.
3	Financial constraints	<ul style="list-style-type: none"> • There are limited funding opportunities for solar projects and solar trainings. • High initial cost of solar infrastructure hinders widespread adoption.
4	Skills gap persists	<ul style="list-style-type: none"> • Insufficient training in solar energy technologies for both teachers and students. • Lack of skilled trainers and teachers for solar training. • Solar training not yet incorporated into existing curriculum.
5	Infrastructure deficit	<ul style="list-style-type: none"> • Many technical institutions still do not have the necessary infrastructure and equipment for solar training.
6	Attitudinal barriers	<ul style="list-style-type: none"> • Since the TVET reforms, there has been high enrolment and better perception of TVET programmes among parents, students, and communities. This is also impacting on increased interest in solar trainings. • TVET solar training is perceived as a better and faster pathway to employment and economic empowerment. • TVET student motivation is very high with regards to solar training.
7	Market risks	<ul style="list-style-type: none"> • Security of solar installation in isolated areas needs to be improved. • Market uncertainties affect the rate of solar systems adoption.

5. Best practices in greening TVET training in Uganda's solar sector

Most universities and research institutes within universities offers two types of training programmes around solar technologies:

- Solar trainings offered by universities and research institutes
- Solar trainings offered by TVET institutions
- Solar trainings offered by non-formal training academies.

5.1. Solar trainings offered by universities and research institutes

Most universities and research institutes within universities offers two types of training programmes around solar technologies:

- **Postgraduate programmes** in the form of Masters and Doctoral programmes in renewable energy where solar is treated as a module in the programme.

Ghana's postgraduate education in renewable energy, particularly solar technology, is led by Kwame Nkrumah University of Science and Technology (KNUST) and Ghana Technology University College. KNUST's MSc program in Renewable Energy Technologies, launched in 2011 with international support, has trained over 100 engineers and scientists, solidifying KNUST's leadership in this field. The program spans approximately 18 months and includes a comprehensive curriculum covering the entire renewable energy spectrum.

To pursue a Master's degree in Renewable Energy Engineering or related fields in Ghana, applicants must meet specific requirements. Academically, a minimum of a second-class lower division in relevant fields such as Engineering or Physical Sciences from a recognized university is required. Applicants with third-class degrees may be considered if they have 2-5 years of substantial industry experience. Professional experience is crucial, with candidates needing 1-2 years of relevant experience in the renewable energy or related industries.

- **Short courses in solar technology** targeted at people without any pre-requisite knowledge or skills. These trainings often last one-week in duration and are targeted at upskilling those already working in the solar sector or those who are interested in entering the solar systems design and installation business.

Institutions offering short courses to accelerate training in solar energy often obtain funding support by partner European organizations. The Brew-Hammond Energy Centre, for example, provides essential training, research support, and expertise in energy management and policy analysis. This is vital for sustainable energy usage to meet Ghana's developmental needs and achieve ECOWAS targets and the SDGs.

5.2. Solar trainings offered by TVET institutions

In Ghana, TVET institutions play a crucial role in the development of skilled labour for the renewable energy sector, particularly in solar energy. The growth of the solar industry in Ghana has led to an increasing demand for technicians and engineers who are well-trained in the installation, maintenance, and management of solar energy systems. Some institutions present in this space includes: Accra Technical Training Centre (ATTC), Koforidua Technical University, Don Bosco Training Institute. Most solar trainings in TVET institutions are often embedded in existing 2 – 3 year electrical installation and maintenance programmes.

Institutions like Green Solar Academy organize their programmes as dedicated short courses which run for a duration between 3 weeks to 3 months. Other programmes, such as those run by the Green People's Energy for Africa are organized with the support of the German Agency for International Cooperation (GIZ). The GIZ partners with some companies and Institutes to help sponsor short courses aimed at upskilling participants to work in the solar space.

There are other partnerships and collaborations that have aided the development of more solar training opportunities in Ghana. For example, the DSTC Solar Training Centre was established in 2009, in technical cooperation with Global Sustainable Energy Solutions of Australia and the department of Mechanical Engineering and Agriculture of KNUST at Kumasi. This partnership provided a framework that has helped trained hundreds of trainees fit for the industry.

5.3. Solar trainings offered by non-formal training academies.

Non-formal training academies by companies offering short-term solar trainings are not as prominent in Ghana. However, there are a few companies that would rather train their participants in partnership with a recognized TVET institution so as to aid the process of assessment and certification of the learners. An example is the Green Solar Academy, whose aim is to create Africa's largest network of solar installers and to make renewable energy accessible for all. They focus on providing the needed solar training by upskilling before getting the trainees into the companies.

6. Concluding thoughts and key takeaways

Here are some important takeaways:

- Solar adoption and use is largely viewed as a way to reduce energy cost since grid electricity is very expensive. Hence, the need for more skilled manpower in solar systems installation and maintenance.
- Solar systems training is governed by three important group of actors: Commission for TVET (CTVET) responsible for curriculum development and approval; TVET Service, responsible for programme implementation, provision of learning facilities, and training of teachers; Electrical/renewable energy Sector Skills Board, comprising representatives of the industry.
- Most solar trainings in Ghana happens at the cycle 2 (senior secondary/TVET) and cycle 3 (universities and research institutes) of the Ghana education system.
- Most solar trainings offered by Universities and research institutes are in the form of short courses (to help quickly upskill the labour force) of post graduate courses in renewable energy.
- Most solar trainings in TVET institutions are often embedded in existing 2 – 3 year electrical installation and maintenance programmes.
- Many technical institutions still do not have the necessary infrastructure and equipment for solar training.
- More teacher training is required for the effective implementation of solar trainings in Ghana.

Acknowledgement: We recognize and acknowledge the kind support of the European Commission for the financial support provided for this SHINE project (grant number: 101129202).

References

1. Atuahene SA, Sheng QX. Powering Ghana's future: unraveling the dynamics of electricity generation and the path to sustainable energy. Environ Sci Eur 2023. <https://doi.org/10.1186/s12302-023-00732-5>.
2. Energy Commission of Ghana. 2022 ENERGY OUTLOOK FOR GHANA. Accra Ghana: Energy Commission of Ghana; 2022.
3. Energy Commission of Ghana. Energy Outlook for Ghana 2024. <https://www.energycom.gov.gh/planning/data-center/energy-outlook-for-ghana> (accessed August 1, 2024).
4. UNESCO. TVET Country Profile - Ghana. UNESCO Int Cent Tech Vocat Educ Train 2024. <https://unevoc.unesco.org/home/Dynamic+TVET+Country+Profiles/country=GHA> (accessed August 22, 2024).
5. Amoako-Kissi M. Ghana's NQF in the making. 5th ACQF Peer Learn. Webinar, 2020.
6. CTVET Ghana. Ghana TVET Report 2021. Comm For Technical Vocat Educ Train 2022. <https://ctvet.gov.gh/wp-content/uploads/2022/09/GHANA-TVET-REPORT-2021SIGNED.pdf>.